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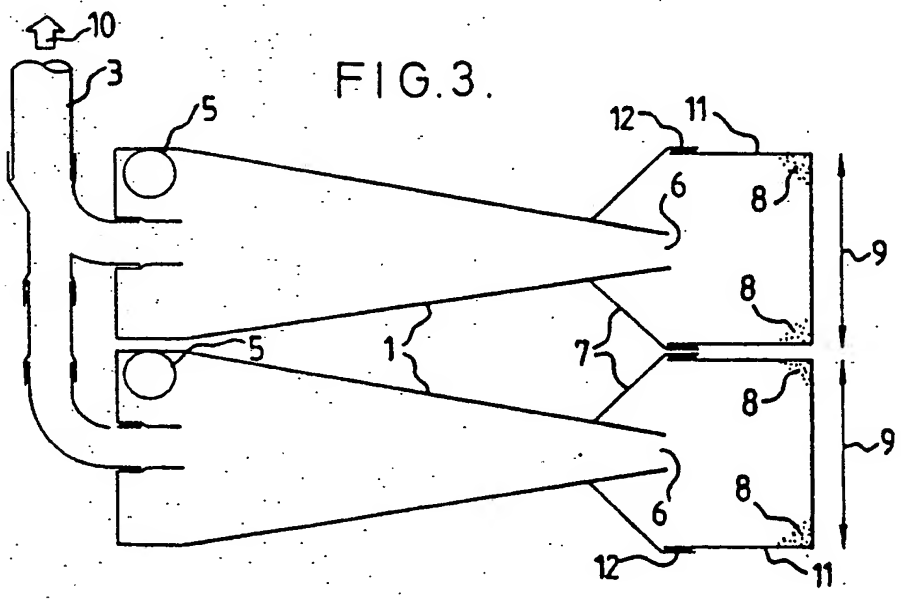
(54) A gas separating apparatus

(57) A gas separating apparatus has a single cyclone (1) and a chamber (7). Dirty gas takes a helical path around the interior of cyclone (1) and fine dust and dirt (8) are separated from the gas and collected in chamber (7). The chamber (has a maximum internal diameter (9) of at least three times that of the open small diameter end (6) of the cyclone which projects into the chamber (7). A plurality of single cyclones (1) may be connected in parallel by means of a gas inlet manifold and a gas outlet manifold (3) such that large gas volume flow rates may be accommodated. The apparatus ma be used for cleaning exhaust gas from an engine or air used for ventilation of a building or the interior of a vehicle.

FIG.3.



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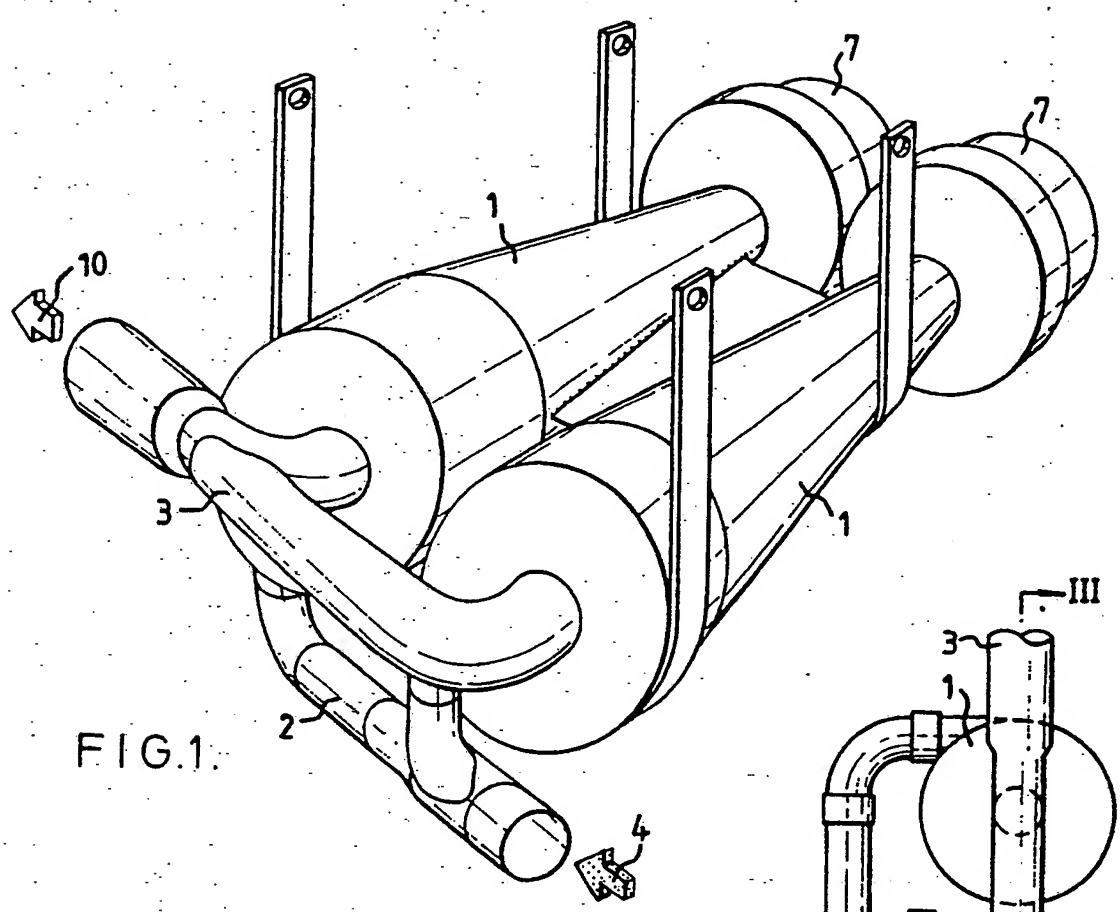
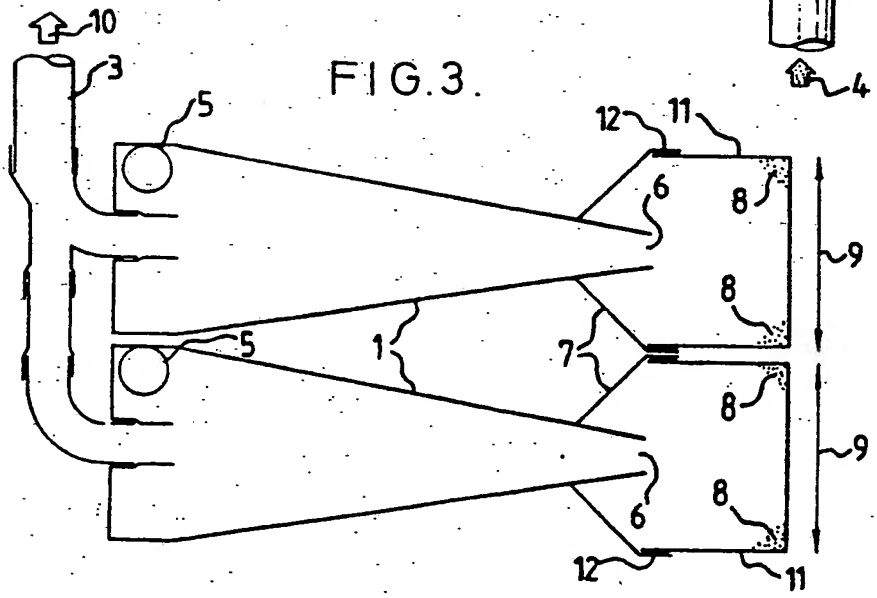


FIG.1.

FIG.2.

FIG.3.



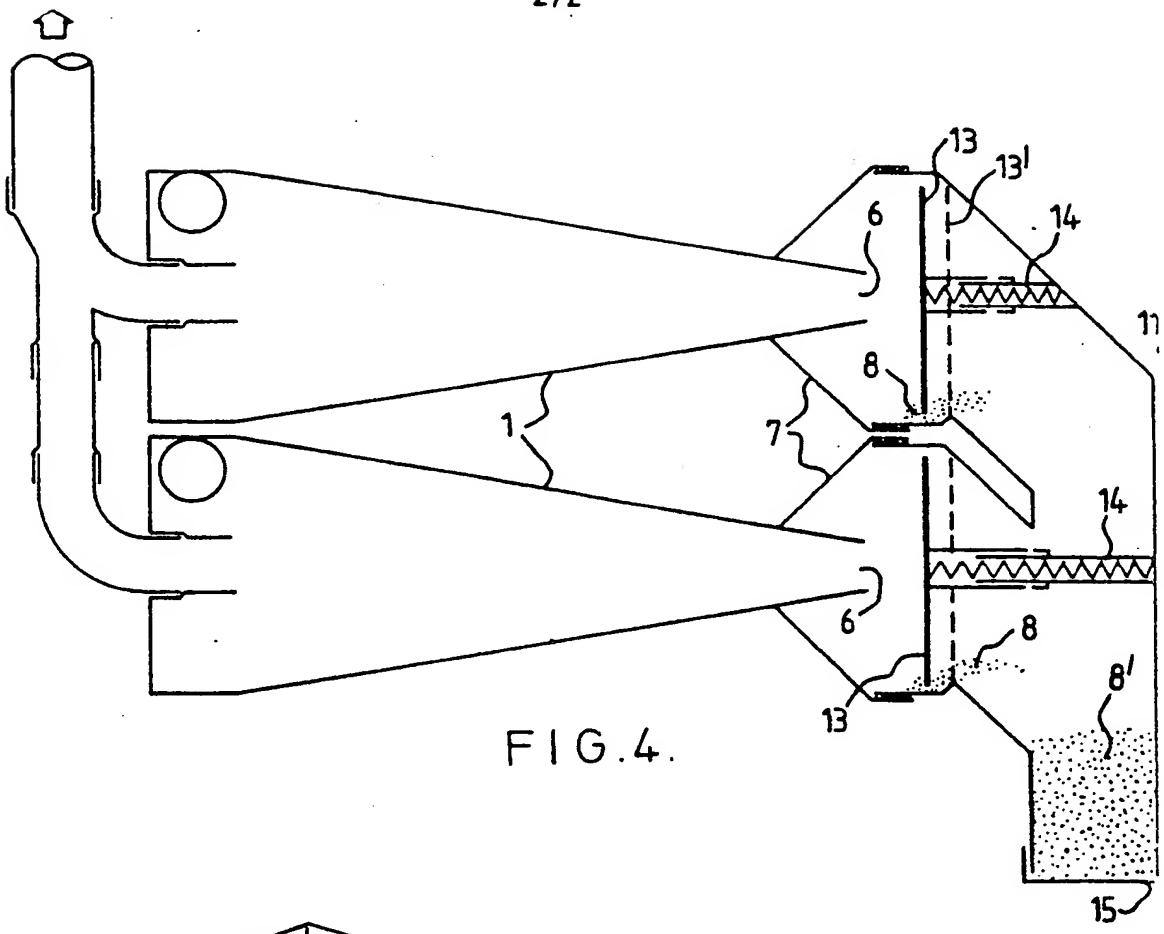


FIG.4.

FIG.5b.

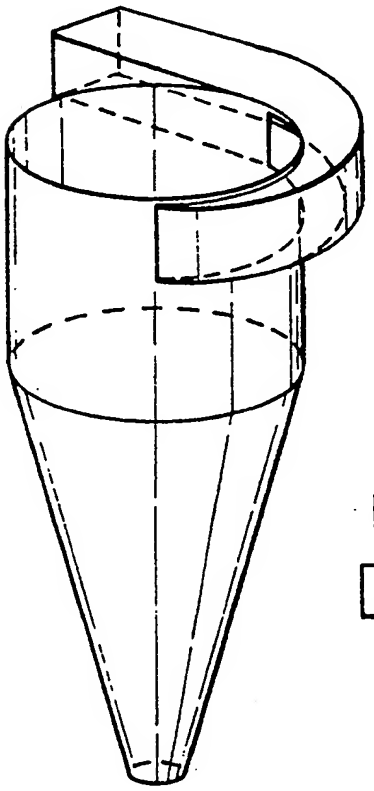


FIG.5a.

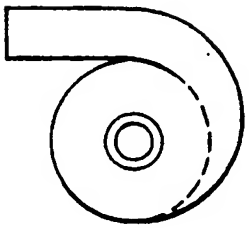


FIG.6b.

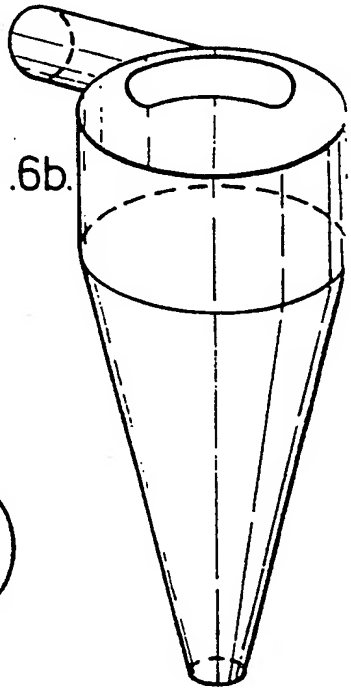
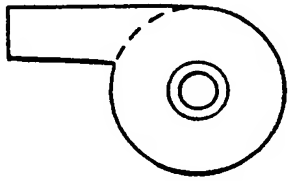


FIG.6a.



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Title:- A gas filtering apparatus

The invention relates to a gas filtering apparatus, particularly but not exclusively for use in a vehicle.

The principle of separation by centrifugal force is well known and has been used in industry to separate dust particles out of an airstream. However, the efficiency of known cyclones is low when dust particles smaller than 50 microns are present. Many gases of particulate content below 50 microns require filtering and current fine dust separation systems for these gases have efficiencies of 50% or lower.

An object of the invention is to remove fine particles such as dust and dirt (hereinafter referred to as dirt) from a gas such as exhaust gas from an engine, or air. This is achieved according to the invention by a gas filtering apparatus comprising a single cyclone, the cyclone having a circular cross section, a substantially tangential gas inlet for supplying dirty gas to the cyclone, an interior surface of frusto-conical shape such that dirty gas supplied to the cyclone takes a helical path around the interior surface, and a substantially central gas outlet for removing clean gas

from the interior of the cyclone, the gas inlet and outlet both being positioned adjacent the end of larger internal diameter of the cyclone, the end of smaller internal diameter of the cyclone being open and projecting into a chamber for receiving dirt and having a portion of circular cross-section with a maximum internal diameter of at least three times that of the open end of the cyclone.

The substantially tangential gas inlet may be a scroll inlet or a simple tangential inlet.

Separation of the dirt particles from the gas takes place as the dirty gas follows the helical path around the interior of the cyclone and is passed via the open end into the chamber. The dirt is collected in the chamber. During the passage of the gas along the length of the cyclone, clean gas is progressively drawn from the helical path to the centre of the cyclone. The clean gas outlet is positioned centrally in order to avoid any dirty gas being drawn out of the cyclone with the clean gas.

This method of filtering has the advantage that no mesh or filter through which the gas must pass is needed. There is no risk of clogging or reduction in efficiency or flow as occurs in other filtering systems.

A further advantage is that the apparatus may be used in any orientation since the movement of the dirt particles after separation is governed by the momentum imparted in the cyclone thereto. The effects of gravity are negligible.

The apparatus may be used to filter large gas volume flow rates by the provision of a plurality of single cyclones disposed in parallel. The gas may preferably enter and leave each cyclone via inlet and outlet manifolds.

This arrangement is particularly applicable to the filtration of exhaust gas from an engine, particularly a diesel engine. The apparatus has a consistently high efficiency with a dirt particle size range similar to that of a diesel vehicle exhaust (0.1-1.0 microns) and the adaptability of the gas flow capacity of the apparatus by the addition of further single cyclones in parallel allows the apparatus to be used with a wide range of engine sizes. Filtration of exhaust gases results in a reduction in pollution emitted by the engine during operation since only the clean gas is expelled into the atmosphere. The cleaned exhaust gas may be re-used if required. The separated dirt particles may be emptied from the vehicle in a non-polluting manner.

A further application of the apparatus is the filtration of the air intake of an engine. The volume flow rate capacity may be varied by the number of single cyclones used as described above. Filtration of the air intake is desirable in order to reduce the possibility of damage to the engine.

Filtration of air used for ventilation is also desirable and the apparatus may be used to achieve this. The ventilation system may be in a building in which case means for drawing air through the apparatus may be provided. Alternatively, the ventilation system may be for the interior of a vehicle.

When the apparatus is used in a vehicle, particularly for filtration of exhaust gas, the dirt must be easily removable from the apparatus since excessive accumulation of dirt will ultimately block the cyclone. This may be achieved by positioning the apparatus such that the chamber of each single cyclone is accessible by a vehicle user and may be emptied of dirt by means of, for example, a removable screw-cap. Alternatively, where a plurality of single cyclones is used, a common dirt-collecting container may be connected to all of the separate chambers such that only one emptying process need be carried out. The maximum engine operation time between emptying of the chambers or container will

depend upon the sizes thereof.

Embodiments of the present invention will now be described with reference to the accompanying drawings, in which :-

Figure 1 is a perspective view of a first embodiment of a gas filtering apparatus according to the invention having two parallel single cyclones and separate chambers;

Figure 2 is an end view of the apparatus of Figure 1;

Figure 3 is a longitudinal section of the apparatus of Figures 1 and 2 taken along the line III-III shown in Figure 2;

Figure 4 is a longitudinal section of a second embodiment of a gas filtering apparatus having a common dirt-collecting container;

Figures 5a and b are respective plan and perspective views of a scroll inlet device; and

Figures 6a and b are respective plan and perspective views of a simple tangential inlet device.

The first embodiment shown in Figures 1 to 3 has single cyclones 1 positioned alongside each other and connected in parallel by gas inlet manifold 2 and gas outlet manifold 3. Dirty gas, represented by arrow 4, passes along inlet manifold 2 and enters cyclones 1 via tangential openings 5. The dirty gas takes a helical path around single cyclones 1 and passes through open ends 6 into chambers 7. Dirt and dust particles 8 collect in the chambers 7 which have maximum diameters 9 of at least three times those of the open ends 6.

After the removal of dirt and dust particles 8, the gas passes via the open ends into the interior of the single cyclones 1 and into the outlet manifold 3 from which clean gas, represented by arrow 10, is expelled.

The chambers 7 have removable dirt-collecting portions 11 which allow the chambers 7 to be emptied of dirt. The means of removal may be by interengaging screw-threads 12.

Figure 4 shows a second embodiment of the apparatus having a common dirt-collecting container 11' for both single cyclones 1. Each chamber 7 contains a seal 13 mounted on a spring or other resilient bias 14. During a period of operation, the pressure of the gas in the cyclones 1 and chambers 7 keeps the seals 13 in a closed

position, shown by broken lines 13'. The dirt and dust 8 separated from the gas then collects in the chambers 7. At the end of the period of operation the pressure on seals 13 is released and the seals 13 move to an open position as shown in Figure 4. At the start of the next period of operation, the pressure of the gas building up in the chambers 7 will force the previously collected dirt and dust 8 past the open seals 13 and into the common dirt-collecting container 11'. Further increase of gas pressure in the chambers 7 will cause the seals 13 to move into the closed positions 13' and collection of the dirt and dust 8 in chambers 7 will recommence. Removal of the collected dirt 8' from the common dirt-collecting container 11' is via a removable screw-top 15.

The scroll inlet shown in Figure 5 is an alternative inlet to the simple tangential inlet shown in Figure 6. Either inlet may be used to initiate the helical path of the gas in the cyclone.

The second embodiment is the preferred embodiment for filtering exhaust gases in vehicles with diesel engines of up to 4 litres capacity, particularly motor cars. The gas inlet manifold 2 may be attached to the engine exhaust outlet such that the exhaust gas is filtered before being expelled into the atmosphere. The

apparatus may be mounted on the vehicle chassis by means of brackets and positioned such that the screw-top 15 is accessible for easy emptying. Larger engines are estimated to require a larger number of single cyclones in parallel, all of which may be associated with a single common dirt-collecting chamber.

Air intake filtering apparatus for an engine is positioned such that the gas outlet manifold 3 is attachable to the intake manifold of the engine, the gas inlet manifold 2 of the apparatus being free to take in air from the atmosphere.

Neither the air intake nor exhaust gas filtering apparatus require means for drawing gas through the apparatus since the engine provides suction at the air intake thereof and expels high speed gas at the exhaust outlet thereof. Air filtering apparatus for use in a ventilation system may require means for drawing air through the apparatus. This may be achieved using a simple fan.

Exhaust gases may have temperatures of approximately 500°C on leaving the engine. Exhaust gas filtering apparatus must therefore be capable of operating at these temperatures and should be made of a material such as diecast aluminium, steel plate or 30% Fibre

Reinforced Polyetheretherketone. The method of manufacture must provide perfect seals and joints and good geometrical roundness of the cross section of the cyclones. The single cyclones may be cast or moulded together in multiples and may be connected by flanges or plates in order to form a single rigid unit.

CLAIMS:

1. A gas filtering apparatus comprising a single cyclone, the cyclone having a circular cross section, a substantially tangential gas inlet for supplying dirty gas to the cyclone, an interior surface of frusto-conical shape such that dirty gas supplied to the cyclone takes a helical path around the interior surface, and a substantially central gas outlet for removing clean gas from the interior of the cyclone, the gas inlet and outlet both being positioned adjacent the end of larger internal diameter of the cyclone, the end of smaller internal diameter of the cyclone being open and projecting into a chamber for receiving dirt and having a portion of circular cross section with a maximum internal diameter of at least three times that of the open end of the cyclone.

2. A gas filtering apparatus as claimed in claim 1, wherein the chamber comprises means allowing the removal of dirt collected therein.

3. A gas filtering apparatus as claimed in claim 1 or 2, wherein a plurality of the single cyclones are connected in parallel by means of a dirty-gas inlet manifold and a clean-gas outlet manifold.

4. A gas filtering apparatus as claimed in claim 3,

wherein each chamber is connected to a common dirt-collecting container comprising means allowing emptying of dirt.

5. A gas filtering apparatus as claimed in claim 4, wherein means are provided between each chamber and the common dirt-collecting container such that during operation dirt collects in each chamber and is subsequently passed to the common dirt-collecting container.

6.A gas filtering apparatus as claimed in claim 5, wherein the means between each chamber and the common dirt-collecting container comprise a seal between the chamber and the container movable against a resilient bias and allowing passage of dirt in the chamber to the common dirt-collecting container at the end of a period of operation or at the start of a subsequent period of operation.

7. A gas filtering apparatus as claimed in any one of the preceding claims, wherein the apparatus is made of a material such that the apparatus is operable at temperatures of at least 500°C.

8 A gas filtering apparatus as claimed in claim 7, wherein the material is diecast aluminium.

9. A gas filtering apparatus as claimed in claim 7, wherein the material is steel plate.

10. A gas filtering apparatus as claimed in claim 7, wherein the material is 30% Fibre Reinforced Polyetheretherketone.

11. A gas filtering apparatus as claimed in any one of the preceding claims, wherein the gas inlet or gas inlet manifold is attachable to an engine exhaust.

12. A gas filtering apparatus as claimed in any one of claims 1 to 10, wherein the gas outlet or gas outlet manifold is attachable to an air inlet or air inlet manifold of an engine.

13. An engine having a gas filtering apparatus as claimed in any one of the preceding claims.

14. An engine as claimed in claim 13, wherein the engine is a diesel engine.

15. A gas filter apparatus as claimed in any one of claims 1 to 10, wherein the gas outlet or gas outlet manifold is attachable to an air inlet or air inlet manifold of a ventilation system of a vehicle.

16. A vehicle having a gas filtering apparatus as claimed in any one of claims 1 to 12 and 14.

17. An air conditioner having a gas filtering apparatus as claimed in any one of claims 1 to 10, 12 and 14.

18. A gas filtering apparatus substantially as herein described with reference to any one of the embodiments shown in the accompanying drawings.